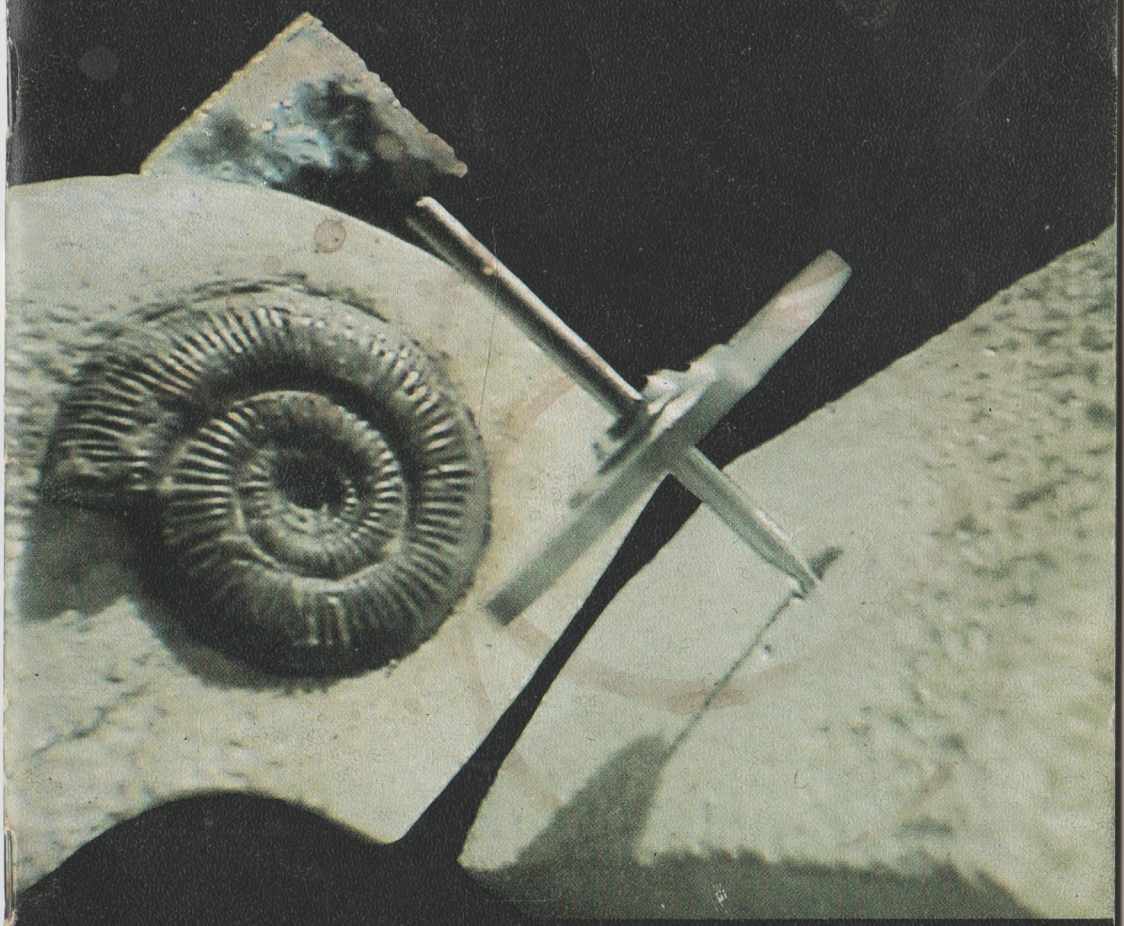
HORIZON



Colonizing Cyberspace

Transcript of the programme transmitted
22nd April 1991

Colonizing Cyberspace

Transcript of the programme transmitted
22nd April 1991

Dear **Horizon** viewer

I first came across the subject of virtual reality in 1989 during the making of an earlier film for the BBC called *Hyperland* with Douglas Adams which explored the future convergence of television and computers. During the research for the programme we discovered several teams in California experimenting with head mounted displays. They were attempting, quite literally, to climb inside the world of the computer.

I vividly recall visiting Scott Fisher one afternoon at NASA's Ames Research Center, south of San Francisco. Scott was leading one of the most ambitious early virtual reality projects and his group was pioneering the use of the dataglove to interact with 3D computer graphics. He invited me to try out the system and I remember my sense of nervous anticipation as I pulled on the delicate instrumented glove and clamped on the heavy 'eyephones' helmet with the NASA logo emblazoned on the front. Despite the crudeness of the graphic display I was convincingly drawn into a simple alternative reality and I immediately sensed the enormous possibilities of the new medium. From my vantage point high above the virtual office, I remember turning to look into the blackness all around. It was like staring into the future. I knew that very soon the black void would be humming with a rich variety of human activity.

It is impossible adequately to describe in words or even on television the experience of visiting a virtual reality. In *Colonizing Cyberspace* we use multiple layers of video to show simultaneously the person wearing the equipment and the electronic landscape in which they are moving around. But even this trick can convey only a hint of the experience. It is as different as reading about a foreign country and actually visiting it for oneself.

Ian Duncan and I have produced a programme that takes the viewer on a journey to the first outposts on this new electronic frontier. We have concentrated on the people, the culture and the exciting possibilities of this new medium rather than on the nuts and bolts of goggles, gloves and computers. It has been a fascinating adventure and we hope you can share our excitement in following the birth of a technology that will undoubtedly change all our lives.

Max Whitby
Producer

NARRATOR (SIR MICHAEL HORDERN):

Welcome to the universe of information. There is an infinite amount of it, which sometimes makes it difficult to comprehend. Pictures and images can help us grasp things.

(*Computer graphics*) Here are some images of buildings, which are places we are used to entering and exploring. Let's do just that. (*Doorway marked 'Cyberspace'*) In this one are some of the people who have been exploring the buildings ahead of us, and some who constructed them in the first place - out here, on the new electronic frontier.

JARON LANIER (*VPL Research Inc.*):

You get your experience through your sense organs - your eyes, your ears and your skin - and most of those are right at the surface of your body. So if you wear the right computerised clothing over your sense organs, you can synthesise any experience - in fact you can even change your own body, you can become a giant zebra or a praying mantis.

BRENDA LAUREL (*Telepresence Research*):

When I think about virtual reality today, what I always end up thinking is there's got to be more to this medium than just looking at the arse-end of a computer graphic.

DR JONATHAN WALDERN (*W Industries*):

People are going to become very attached to another world, a world in which they can exist, where they know they're safe, they know they can enjoy themselves and they know they can escape from the day-to-day hassles of real life.

DR MICHAEL McGREEVY (*NASA Ames*):

We'll be able to bring Mars or the moons of Uranus virtually down to Earth; we will be able to put them in the living rooms of everyone who supports space exploration. It will essentially revolutionise space exploration.

DR THOMAS FURNESS (*Ex US Air Force*):

What we would ideally like to create is a computer that you wear, so that instead of having a glass barrier that separates your mind from the mind of the computer, with virtual reality we're able to break the glass. The computer pulls us inside and creates a world for us that we can interact with, using our natural three-dimensional abilities.

NARRATOR:

The worlds they are talking about are ones that hitherto have only existed in people's imaginations, but which now can actually be constructed inside computers where they become what is known as VR, or virtual reality. (*Computer graphics*) Each of the things in here represents a different aspect of the story. We can fly into any one of them and find out what VR is all about.

DR JONATHAN WALDERN:

Let's take that over and that Apache helicopter's flying back in this direction, so now what I do is just go and reposition the Harrier over here, take that round, this is something... You've got to be careful because these things are getting a little bit out of control...

NARRATOR:

This fellow is Jonathan Waldern. He's built one of the first off-the-shelf virtual reality systems.

DR JONATHAN WALDERN:

There are three key elements. Firstly, a very powerful computer to provide the computer graphics and the sound to convince me I'm in the electronic world. Secondly, sensors in my glove and in my helmet to detect where I am in that world. Thirdly, the visor itself, which gives me the correct stereo view of the three-dimensional world, and the stereo sounds convincing me the objects are in the world itself.

There she goes. Let's take that round. Watch out for the Apache because it's coming back!

Hello there, Michael. Thought you'd like to try the Virtuality system.

MICHAEL FRAYN (*Novelist and playwright*):

This is the kit?

DR JONATHAN WALDERN:

That's right. Just pop that straight over your shoulders...

NARRATOR:

Twenty-five years ago, Michael Frayn imagined something rather like virtual reality in his novel *A Very Private Life* (Flamingo, 1984). Out of curiosity, Michael Frayn accepted Jonathan Waldern's invitation to try the real thing.

DR JONATHAN WALDERN:

That's it, and just secure it down until it's comfortable. And I'm going to give you a little joystick here. And what you do is look into the world and when you see where you want to go, press the top button to record it, and then to actually go there, press your trigger.

MICHAEL FRAYN:

Right. Well I'm in a room with a nice tiled floor and somebody standing over by the door, and there's a window with a view out there with green hills, and there's a red table. This is absolutely extraordinary because when you turn your head you do actually occupy the room. I'll tell you what, this is a very clean, nice, simple house to live in. What it's like is the kind of house you have in children's stories, where everything is simple, primary colours and there are no problems, there are no mortgage repayments to pay, or anything like that. It's like those children's stories where the children fall asleep over the story-book and then they find themselves walking into the picture, into this simple world.

JOHN BARLOW (*Electronic Frontier Foundation*):

If you work with words you're painfully aware of their inadequacies.

The beauty of poetry really is its ability to actually come up with something given how thin the tools are.

NARRATOR:

John Barlow is a writer too. He writes lyrics for the Grateful Dead, a band famous for their rather special views on reality. John is also a science writer and has followed the development of virtual reality from the beginning.

JOHN BARLOW:

Here we have a medium that can incorporate every other medium that ever came before it - ranging all the way from graphics, as in cave paintings, to text, to television, to auditory communication like the telephone - and create integrated worlds in which all these things are together for the first time. This form incorporates everything that can be incorporated. It incorporates experience itself.

MICHAEL FRAYN:

There is this absolutely idyllic green world outside, full of trees, and you can actually step out into the landscape - I've just flown through the window, the way you never can in life, which is very nice. Is the house still there? Yes, I can see, there inside is this very nice room I've left.

JOHN BARLOW:

The first thing that I noticed about it was the sense that I was disembodied. Even though I had the ability to interact physically with this completely immaterial world, all I had was my hand. There was all this black space beyond, below, to the sides, and I pointed up and went up the equivalent of about 100 yards and looked down at my little office world and felt incredibly lonely. Even though I could still sense the physical presence of other people in the room where my body was, the place where my mind was was not a place where anybody else existed,and I wanted there to be other people there as quickly as possible.

MICHAEL FRAYN:

(*Computer graphics*) Where's the house? OK, there it is and there's a sinister purple figure who's been lurking in it for a long time. I want to find out who it is.

DR JONATHAN WALDERN:

Hello there, Michael.

MICHAEL FRAYN:

Hello, who is it?

DR JONATHAN WALDERN:

Hello, it's John here.

MICHAEL FRAYN:

You look strange, you look rather purple.

DR JONATHAN WALDERN:

So do you. In fact, to me you look like a robot with a little red bikini on...

NARRATOR:

Jonathan Waldern is physically located in a different room, and he and Michael Frayn are networked together in the world of the computer. If this seems like science fiction come true, it's because that's exactly what it is. Michael Frayn is one of many writers to have anticipated the existence of virtual worlds.

MICHAEL FRAYN:

(*Reading from* A Very Private Life) Once upon a time there will be a little girl called Uncumber. Uncumber will have a little brother called Sulpice and they will live with their parents in a house in the middle of the woods. There will be no windows in the house because there will be nothing to see outside except the forest, while

inside there will be all kinds of interesting things - strange animals, processions, jewels, battles, mazes, convolutions of pure shapes and pure colours which materialise in the air at will...

READERS (*Extracts from science fiction novels*):

'...lowered the lenses making sure the opti-fibre cable from the socket beneath his left ear was securely plugged into the edge of...'
Dan Simmons, *Hyperion*, Headline, 1991

'...recombined with themselves or with stock graphics to form...'
W. T. Quick, *Dreams of Gods and Men*, Orbit, 1990

'...to most of the human race for the greater part of its history. Alvin had only to frame the appropriate thought and the walls had become windows opening upon...'
Arthur C. Clarke, *The City and the Stars*, Gollancz, 1968

'...it was fully 15 seconds before the round plate that she held in her hands began to glow, a faint blue light shot across it darkening to purple...'
E. M. Forster, 'The Machine Stops' in *Collected Short Stories*, Penguin, 1989

'...behind the ice shield I was already getting a local anaesthetic. Then the connection snaked under my eyelids and around my eyeballs to the optic nerve, big splashy colour explosions when they made contact...'
Pat Cadigan, *Mind Players*, VGSS, 1988

'...cyberspace, a consensual hallucination experienced daily by billions of legitimate operators in every nation, a graphic representation of data abstracted from the banks of every computer in the human system, unthinkable complexity, lines of light ranged in the non-space of the mind.'
William Gibson, *Neuromancer*, Grafton, 1989

NARRATOR:

For such a futuristic subject, virtual reality has a surprisingly rich past. (*Computer graphic*) This museum is where they keep the historical relics. In here are all the people and inventions that have

contributed to the development of virtual reality.

JOHN BARLOW:

VR as a technological development has been around for a fairly long time. The first VR was the Stereopticon, which was a three-dimensional form of photography that gave people the sense of being in the place at a distance, which I think was a pretty big deal for the Victorian era. Morton Heilig was a renegade film-maker who decided that it wasn't enough to be inside the movie house. He wanted to be able to stick his head in the movie itself and so he set about making a machine that would make that possible. This machine became, in a way, the 1962 Cadillac of virtual reality. This thing had everything but tail-fins.

MORTON HEILIG:

I have this vision that 1,000 years after a nuclear explosion some Martians will come down to Earth. They'll see a big mound of vines growing in this backyard (of course all humanity will be gone), and they'll uncover all these vines and then, lo and behold, underneath they'll discover a huge icon. They won't understand what it is, of course, standing there like some Easter Island head of a lost civilisation. And if they're lucky enough to happen to have a quarter on them, which is very unlikely, but you never know, they take a quarter and they might sit on this thing and just put their quarter in, and lo and behold: Sensorama.

Sensorama is a one-man experience simulator with fairly good peripheral imagery. This machine gives about 100 degrees horizontally, 100 degrees vertically, and you're getting true 3-D, that is left and right eye images, so everything is in space; and you're getting binaural sound because you have a left and right arch speaker. Your whole body is floating on a rubber base with vibrations so your whole body vibrates synchronised with the velocity of the vehicle that you're riding. You get wind against your entire body and of course you get smells. The smells are synchronised with the films, so that if you're in a flower market you smell flowers, if you're at the beach you smell sea breeze, and if you're in a park you smell cut grass and so on. Nowadays you have a cameraman, a sound man, but in the future there will be a smell man, somebody who's expert at smells. You'll have machines that

will literally record smells, that will mix smells, that will project smells and so forth, and that will come in the future.

Ah yes, this is the belly dancer, a beautiful belly dancer, she's dressed in an oriental costume. If anybody look great in 3-D she does, she's got all the 3-D accoutrements. Actually she's a very lovely Jewish girl that I found in Brooklyn.

After trying for 30 years to get funding to build the experience cinema, or to carry Sensorama forward, I kept banging my head against stone walls and just couldn't get anywhere, so I finally had to put it aside and get into other things. Now virtual or artificial reality has come along and somehow or other people have discovered my work and they've been coming to me as some kind of reborn Rip Van Winkle. A lot of them are very surprised that I'm still alive, you know, because I did this work 30-35 years ago.

JOHN BARLOW:

In about 1965 Ivan Sutherland, who was the father of computer graphics, started developing something at the University of Utah which became the first head-mounted display. This item was a little bit oversized for daily use, but nevertheless had all the concepts intact.

DON VICKERS (*Ex University of Utah*):

The head-mounted display is a pair of glasses, so to speak, with cathode ray tubes as the temple parts. The object that recorded the position and orientation of the head was attached to the ceiling, it hung down, and it was given a nickname 'The Sword of Damocles'. In 1970 computers were much slower than we're used to today. It took not only the computer, but five six-foot racks of component equipment just to operate the head-mounted display to display something very trivial and very simple. Of course what we were trying to do with the head-mounted display was create an environment where a person would be able to walk inside the data and look at it from inside, would be able to interact with it.

JOHN BARLOW:

Meanwhile, out at Wright Patterson Air Force Base, they had come

up with what was essentially the first practical use of virtual reality - the head-up display for fighter pilots.

DR THOMAS FURNESS:

The fighter pilot's job is perhaps the busiest job on the earth. He has to fly this machine beyond the speed of sound, to keep track of where his friendlies are located, where the enemy aircraft are located, has to pull gs to the boundary of consciousness and be shot at at the same time.

We were concerned about the amount of time the crew member had to spend looking inside the aircraft in order to pull together the information and build a mental model that he needed to perform the mission. We were building upon a technology we called head-up displays, and head-up displays basically project a very simple virtual image off the windscreen of the cockpit, so that the crew member can watch the outside world and see another image superimposed on it, for example a gunsight pipper, at the same time. Our work was to extend that so that we actually brought the head-up display to the visor of the helmet, and now we're able to give the pilot not only a wide field of view projection of information, but do it in stereo. So now they can get a 3-D picture that would move as the crew member moved his head.

One of the things we found was that, as long as we projected a picture that was less than perhaps about 60 degrees, we always thought of that as sort of an object in our current world. It's like walking around in an art museum and you see a picture on the wall. When you remember that picture, you remember it as a picture on the wall in an art museum. But when we extended the field of view beyond about 80 degrees, something magic happened. It was just as if somebody reached out of that picture and grabbed you and pulled you inside.

JOHN BARLOW:

In 1985 the conceptual pieces of virtual reality were pretty much in place, but one missing element was technology cheap enough for anybody but the Department of Defence to afford it. The Japanese provided us with that - the Citizen mini-TV.

DR MICHAEL McGREEVY:

When I was working at NASA Ames research centre I flew to Wright Patterson Air Force Base to meet Tom Furness. I understood that he had a head-mounted display for simulation purposes and I hoped to buy one from him. As it turned out, he was very generous and offered to sell me one for a million dollars. Unfortunately, being a rather poor researcher I didn't have that kind of money and so I was unable to purchase one, but I resolved that when I got back to NASA I would build one myself.

Back at NASA, my colleagues and I were trying to figure how we could build such a display for not very much money, and we resolved to go to Radio Shack and see what we could find. At Radio Shack we found a couple of pocket TVs for $79.95 and we tore them apart and found liquid crystal rays in there with 100x100 array of pixels. We put them into a head-mounted display, and with our head tracker and the wide-angle lenses created a $2,000 head-mounted display.

JOHN BARLOW:

Obviously it wasn't enough to be able to look at a simulated world. We knew a lot about that. What we really wanted to be able to do was to reach in there and grab something. I guess this stuff started to become real for me on that morning in 1987 when I went to the Post Office, took out my *Scientific American* and saw the data-glove on the cover.

JARON LANIER:

This is a data-glove. The data-glove is a device that lets you handle imaginary objects as if they're real and let's you have a physical presence inside the virtual world instead of just being able to see it. The glove measures how you're moving your hand and transfers the movements of your hand into a virtual hand, in this case a skeletal hand, although a lot of times we've had hands that look fleshy. The back of the glove is covered with sensors. They include these fibre-optic sensors which measure the bending of the fingers and they include this device, a magnetic sensor which measures where the hand is in space.

So in virtual reality you can use your hands to do a lot of things you could do in the physical world - you can pick up musical instruments and play them, you can pick up tools and build things. You can do a lot of things you can't do in the real world. There's a little convention we have round here, it actually started at NASA, where you can point in a certain direction, then you fly wherever you pointed.

JOHN BARLOW:

One of the biggest projects, and I think the first to be successful early on, was Scott Fisher's and Mike McGreevy's project at NASA. This started out using various tools that they had developed, or that had been developed at VPL, or elsewhere, and combining them to create a thin but nevertheless quite serviceable virtual reality.

SCOTT FISHER (*Ex NASA Ames*):

One of the things we looked at in a fair amount of detail was this idea of simulating an information space, that is making an abstract data-set into something that you could actually walk around inside of, to make it easier to access that data. We really started out with a fairly simple analogy of just making many windows of information.

You could take advantage of having this space around you and be able to use the gloves to position windows in that space. In fact, we finally got to the point where we could actually grab the windows, stretch them and then use that as a mechanism to pop into another data space, another virtual space.

NARRATOR:

There is one bunch of people who reckon they've already been building virtual realities for years - the designers who make computer graphics, like this for instance. Let's pop in here and meet one of the best designers, Gareth Edwards. Finished computer graphics may have the apparent simplicity of real life, but the way in which imaginary worlds are constructed is immensely complex and time-consuming.

GARETH EDWARDS (*The Moving Picture Company*):

One way to describe what I do for a living is as a builder, a sculptor. I have to take basic information like plans, elevations and photographs, and sculpt, build from just raw numbers.

What I'm going to do is take one of my favourite etchings and build it, create it from scratch, just from the picture. The basic building blocks that I use to establish perspective are cubes. Cubes can be moved very quickly in the computer space. The next process is to assemble the final object, loading each object into the computer's memory, manipulating it, rescaling it if necessary, fitting it together like a huge jigsaw. Every detail, every nut and bolt, every chip and every bit of plaster, all the plaster, all the painting, every single detail has to be created by the builder.

The other thing that I have to start doing at this point is to start thinking about the lighting, where the lighting fits and how it falls within the image. We have to use all the techniques that a lighting director would use lighting a real set. In this space we have a single light-source, the sun, and the bold designs in the shadows are coming from just that one light source.

In the animation that we're about to see it took the computer 50 minutes to create each frame. There are 25 frames per second, and there are 15 seconds in this sequence. Now if you do all the maths on that, that works out at 5,625 minutes, which is something over 93 hours, which is almost four days of continual computation by the computer. That's a lot of time to make just 15 seconds and, I'm not boasting, but I don't use very slow computers.

NARRATOR:

Even the best of today's computers are still far too slow to keep pace with the human imagination. (*Computer graphics of plants growing and unfurling in extravagant convolutions*) This fantastic world is the product of months of machine time. Here the scene, the viewpoint and the movement are all pre-determined. For a visitor to interact with, and explore, a world like this, these high-definition images would need to be generated in real time, which our computers can't do - yet.

So for the moment, virtual realities must be simple enough for today's computers to cope with. Working within this restriction, researchers in Japan, Europe and America have already found a wide range of applications for VR. Here is a collection of objects representing the current state of the virtual art. (*Images of planetary terrain*) This one is for armchair travellers.

DR MICHAEL McGREEVY:

The work I'm currently doing in NASA Ames research centre is virtual planetary exploration. The idea is to take terrain data - numerical data describing the shape and constituents of the terrain - and to re-create the planetary terrain from that data. So what we do is we have a head-mounted display and an exoskeleton allowing us to feel as if, in fact, we are on the planet Mars. We can walk on the surface, we can fly over the surface, we can inspect the various aspects of the terrain. I personally have virtually stood on the surface of Mars and I've flown through the valleys of Mars and flown over the volcanoes, and it's a very compelling experience of presence. The serious side of this of course is that for geologists, exploring the terrains would be a very valuable tool to integrate terrain information.

NARRATOR:

There are some locations back on Earth where being virtually present may be preferable to being actually there. Robots allow humans to be tele-present in difficult, or hostile places. Dangerous real environments can be safely explored when you can visit them as virtual realities.

ROBERT STONE (*Advanced Robotics*):

The pictures I'm getting in my headset are of a 3-D world as seen through the eyes of the robot, so as I move my head to the right and to the left the robot's head moves with me and I can explore that 3-D world. The reason we're using virtual reality is that in many cases it's totally inappropriate to use TV feedback to the human operator: for instance, in sub-sea conditions where the water may be too murky; in dark, nuclear environments; in space; or on the battlefield - in fact, in any environment where it would be too

difficult to send people but we can send robots because they're expendable.

NARRATOR:

Some people believe that the single most important application of this technology will be to turn the massive amounts of abstract information in the modern world into visual imagery that our primitive caveman brains can better comprehend.

DR THOMAS FURNESS:

The normal things we see as numbers, or as alpha-numeric symbols, or whatever, could now be represented as objects in this space. For example, a group of numbers like those produced by the New York Stock Exchange could be visualised as a sea of wheat as if we were standing beside a pasture, and we would see this sea of wheat and each of the individual stalks of wheat would be a stock. As that stock grew, and as the influences of the economy swept over that world, we would see the propagation in how the waves occurred in that sea of wheat. Then if we were interested in a particular stock area, utilities for example, we would see this particular region in our field growing faster than the others perhaps, and then what we would do is reach out with our hand and grab those stalks of wheat and buy a million shares.

NARRATOR:

One application of VR is already making serious money: virtual reality arcades are springing up around the world.

DR JONATHAN WALDERN:

(*Children playing virtual reality games*) These people are interacting together, they're flying together against the enemy, against the foe, and they're shooting and playing together in that same world. They love virtual reality. For the first time they are 'top gun', but they hammer these machines. The real world in entertainment is what we call double military standard - your average youth. We like kids, they are the best test of this machine, they are the people that feed back straightaway whether they like it or not.

INTERVIEWER:

What was that like?

BOY:

Brilliant.

INTERVIEWER:

Well what did it feel like?

BOY:

It feels as if you're really in the plane. Unbelievable.

GIRL:

You're in the plane. You're shooting them and it's brilliant. I love it. You're addicted.

INTERVIEWER:

How was that?

MAN:

That was absolutely brilliant. I'm not an arcade fan, but that was truly amazing.

NARRATOR:

Architects have been using virtual reality to avoid expensive mistakes. Clients can walk around a building in advance of its construction to see if it actually works. Telescopes and microscopes reveal the universe at the largest and smallest scales. Virtual reality will give us direct experience of worlds very different from the one we inhabit. Here, a force-feedback hand-controller provides an accurate sense of the forces acting between molecules. Chemists can grab groups of atoms and manipulate them to design new drugs. Hospitals are investigating VR for the treatment of disease. Here...

JOHN BARLOW:

Oh excuse me, but it seems like you guys are getting a little bit institutional with this stuff. It's fun. If you don't mind I'd like to grab inside your head for a minute and haul it over here and down here where I've got some friends gathered at something called the Cyberthon. The Cyberthon, as it was originally conceived, was supposed to be the 1990s equivalent of the acid test, and we had thought to involve some of the same personnel.

But because of the commercial nature of this, and because of the inherent gismology, it immediately turned into something like a trade show. It immediately acquired a financial quality, or a commercial quality, that was initially a little unsettling to an old hippy like me, but as soon as I saw it actually working then I thought, oh well, if you're going to have an acid test for the 1990s, money had better be involved.

JARON LANIER:

The Cyberthon was one of an extraordinary number of virtual reality enthusiasts' gatherings which have been happening lately. There have been literally hundreds of them all over the world, and I have mixed feelings about them. The Cyberthon was a particularly colourful one and it certainly demonstrated an amazing degree of energy and commitment on the part of the participants to stay up all night.

MICHAEL WAHRMAN (*Animation effects*, RoboCop 2):

For a long time I couldn't figure out what the people who espouse virtual reality were talking about. Then I went up to Cyberthon and spent 24 hours with them, and I realised a lot of them had come out of the Berkeley free speech movement and the psychedelic drug movement, and I realised that they had confused, in my opinion, psychedelic drug experience with transcendent life experience with interactive computer graphics. I think some of it has to do with their desire to strike back at the passivity of television, and also to give their children something to explore that isn't drugs and is positive.

SALLY TISDALE (*Writer*):

I'm surprised at how little a lot of people want to talk about this kind of thing. They don't want to hear about the cons, they don't want to talk about the dark side, they don't want to talk about what if we start doing virtual murder and rape. They don't want to talk about those things, they're not interested in those questions I think because it sort of takes the wind out of the sails.

MAN (*at Cyberthon*):

This is virtual dining. It's one of the two food places here. People have got them confused.

SECOND MAN:

It's all bullshit.

MICHAEL WAHRMAN:

When we actually look at virtual reality, as it's shown to us today, I think it's ultimately disappointing. There are lag times in it, the pictures that we see aren't very interesting on either a visual level or a narrative level. The danger is that people will go away with a negative opinion about something that will be an exciting art form and that it will set the field back from public acceptance.

HOWARD RHEINGOLD (Whole Earth Review):

William Gibson was sort of bemused. He kind of invented this matrix of the future, this cyberspace, without a great deal of knowledge about the history of the technology for making head-mounted displays.

WILLIAM GIBSON (*Writer*):

The speed with which this technology has manifested itself continues to amaze me, but I do worry sometimes when I feel that the people who read those first books of mine, or some of them, seem to have missed a level of irony (*laughter*)...perhaps several levels of irony.

JOHN BARLOW:

The whole thing feels like the frontier to me. You've got these companies that remind me a little bit of the fur companies that were responsible for the original excursions into the West, and they've got kind of a loin cloth and machete quality to them. They're hunkered down and they're doing some pretty fundamental stuff in some pretty fundamental ways, and they're a little rawboned in their competition with one another, which I think is probably appropriate.

NARRATOR:

Perhaps it's no coincidence that VR appeals to the same crowd who brought us flower power, Woodstock and mind-expanding drugs. Virtual reality holds the same promise as the dreams that inspired the 1960s counter-culture, and very probably some of the same dangers. For better or worse, this is where it's all heading.

JOHN BARLOW:

(*Sitting in virtual diner*) Where are we? Did you make this?

JARON LANIER:

Well, I thought you'd like a cheesy diner, you know, it's...you know, it's got that real gritty quality, it's sort of Americana thing, you know. You like that stuff.

JOHN BARLOW:

That's true, I was...

JARON LANIER:

Do you like the dead cow head? I thought that was a pretty touch.

JOHN BARLOW:

Looks like John Lennon a little bit...

JARON LANIER:

It's probably safe to say that this is the first in-depth philosophical debate - if that's the phrase I want - to be filmed entirely on location inside a computer.

JOHN BARLOW:

Another thing I see people doing, another area that people seem determined to make, is to think that this is somehow like psychedelic drugs, or that this will become a great pornographic environment. I mean about...

JARON LANIER:

Yes the great...the fallacies...

JOHN BARLOW:

Exactly. The second question is sex, and the third question is drugs...

JARON LANIER:

What was the first question?

JOHN BARLOW:

The first question is, 'What the hell is it?' I don't understand this. I mean from a sexual standpoint it's like having had your everything amputated, so it doesn't seem very good for that.

JARON LANIER:

My own belief about virtual reality is that if anything it sensitises people to the physical world. I mean, when you spend some time in the virtual world then you come out, just staring at a tree is an incredible experience...

JOHN BARLOW:

You love all that grit.

MICHAEL FRAYN:

It would be appalling to be sentenced to spend the rest of one's life in this world. The world is too simple, it doesn't have enough roughness and opposition in it to engage one's imagination for very long. It's wonderful as an escape from the world of mud and rain and reality, but if you don't have the mud and the rain and the reality you lose not only the sense of the outside world, but eventually I would think you lose any sense of yourself.

JARON LANIER:

I like making worlds really fast. To me speed is really important. The whole thing that's special about language is that we've found the one part of the world we can move as fast as we think - which is this funny tongue object, and to a degree our hands - and we use that to refer to everything because it's as fast as thought. That's how virtual world creation has to be. We have to be able to just make these worlds as fast as we think about them, just like improvised reality, so right now we have...

GARETH EDWARDS:

I don't think those guys are plugged into the same reality that I am. The reality about computer graphics, the reality now, here and now - and for the foreseeable short-term future - is that it's going to take time to create worthwhile, detailed worlds in which the level of information is satisfactory. I think it's a very skilled business to actually create a world.

NARRATOR:

Gareth Edwards may be sceptical of people's capacity to create their own reality, but there is no doubt that today's crude virtual worlds will sooner or later give way to photo-realism, and there are plans afoot to deliver this ultra-high-resolution imagery, using something a little more sophisticated than a pair of mini-TV sets.

DR THOMAS FURNESS:

What we're going to do is change the approach to creating these images and write an image directly on the retina of the eye using

micro-lasers. That way we can create the 4,000x4,000 picture-element display that we feel is necessary to create the fidelity.

NARRATOR:

What are people going to be doing in these hyper-real places?

BRENDA LAUREL:

I know that when you walk into an interesting world, no matter how cool it is, eventually you want something to happen, something interesting to happen, some story to begin, so what this says to me is...dramatic plot, dramatic character. So I spent several years thinking about what a computer would need to know and be able to do in order to support a world like that. I think in five or ten years a person will be able to browse a menu of lots of different worlds that they might enter, and you might make a choice on the basis of the description of the world, or the artists who created the world, or the character that you'd be able to play if you entered the world. To me as an actor, one of the most exciting things is to be able to change not just my body and my clothing and my make-up, but really fundamental things about myself - (*man's talking head*) to change my gender for instance, (*black woman's talking head*) to change my ethnic background, my age.

MICHAEL FRAYN:

If you step on to the stage when they're playing *Hamlet* and you're allowed to interact with the cast, and when Hamlet doesn't know whether to kill Claudius or not, you say 'Oh come on, pull yourself together, kill him, kill him,' and he kills him - then that character has to be able to carry through the implications of his new action in terms of language. He has to be Shakespeare, you have to have a set of Shakespeares on the stage. It's not a plausible proposition.

NARRATOR:

The future may be closer than we think. According to John Barlow, bits of reality are already getting pretty virtual.

JOHN BARLOW:

Well, I like to tell people who don't think that cyberspace applies to them, or that it is some kind of science-fiction concept: cyberspace is where your money is, right now. Unless you've got a few krugerrands buried out at the end of the garden, just about all of your financial assets are expressed in bytes [computer binary digits]. They're sloshing around in the datasphere.

NARRATOR:

Most of us still think of computers as glorified adding machines, or as clever typewriters. Virtual reality implies far more than that. Computers may end up being where an important part of our lives will take place.

JOHN BARLOW:

The enthusiasm over VR is another example of what Paul Sapho calls macro-myopia, which is the willingness of society to overestimate the short-term effects of a technological breakthrough and underestimate its long-term effects. Let's take, for example, computers. Some people regarded them as toys, or as another one of these things from California, until one day they woke up and found out that computers were everywhere, that they were a functional part of their lives as much as toasters. I think you're going to see the same thing with VR. It's going to be dismissed, possibly even forgotten, and then one day in about 15 years we'll wake up and everything will be virtual.

© British Broadcasting Corporation MCMXCI

Produced and designed by Broadcasting Support Services
for **BBC Horizon.**

Printed by In Speed, Luton

For further copies please send a cheque or postal order for £2.00, payable to Broadcasting Support Services, to:

Colonizing Cyberspace
PO Box 7
London W3 6XJ

COMING IN FROM THE COLD
28th January

The new arms control treaties use science to oversee the end of the Cold War and to check on cheating. It's the verification game: how do you give a tank a fingerprint so unique that it cannot be forged? And where does the line lie between checking and spying? From American soldiers, deep inside Russia, X-raying Soviet missiles in the snow, to private firms offering new technologies on the open market, **Horizon** investigates this new growth industry, and how it could bring peace to the world's trouble spots, or more accurate means of attack.

SMALL PROBLEM WITH THE MIRROR
4th February

Hubble trouble: the inside story of the biggest little error on the Galaxy and its impact on its principal 'victims' – all the astronomers who have worked on the Hubble Space Telescope and waited 13 years for dramatic new insights into the origins, evolution, age and ultimate fate of the universe. Now, with the telescope's mirror badly flawed, **Horizon** follows their efforts to retrieve the science from this observatory in space and to plan a rescue package to restore its original planned performance. Can Nasa's engineers be trusted with 'big science' any more?

CALIFORNIA DREAMING
11th February

The car was the American dream. But Los Angeles is now the urban nightmare – a city built around the car with choking smog. **Horizon** looks at the auto industry's response: electric cars and convoys of self-driving cars. But there is also social engineering. Can a new style of city be designed that ends the love affair with the car?

OTHER TRANSCRIPTS AVAILABLE FROM THIS SERIES OF HORIZON:

Each transcript is £2.00 and cheques, made payable to BSS, should be sent to:
Horizon: (name of programme), PO Box 7, London W3 6XJ

THE DAY THE EARTH MELTED
18th February

Sixty-five million years ago, on the west coast of present-day India, the earth's crust cracked open. A series of volcanic eruptions, thousands of times bigger than anything mankind has ever witnessed, created the spectacular landscape seen there today. The effects were felt around the globe and may have driven the dinosaurs to extinction. Why does the earth suffer outbursts of volcanic activity? **Horizon** relates the 20-year search which has led to a new theory explaining how the earth's crust was built.

THE CURSE OF KARASH
25th February

Balkan scientists may have discovered the key to unexplained kidney diseases around the world. At the end of the Second World War, doctors in the Balkan countries discovered that whole villages – like Karash in Bulgaria – were being wiped out by a rare kidney-wasting disease. **Horizon** tells the story of the search to isolate the cause.

PLAYING AT NOAH
4th March

The Javan rhino of Indonesia could be extinct within 30 years. Zoos think they should capture the rhinos in order to breed them in captivity – and the test tube. It is part of the hi-tech approach to build 'frozen zoos' – using techniques such as in-vitro fertilisation, surrogate parents and embryo-splitting to keep animals 'alive' until the 22nd century when biologists predict there will be enough space for them to return. **Horizon** follows the quest of Dr Ulysses S Seal, a charismatic evangelist in the conservation world, who persuades governments to let his scientists remove animals or their embryos from the wild to come aboard his 'technological ark of species.

Each transcript is £2.00 and cheques, made payable to BSS, should be sent to:
Horizon: (name of programme), PO Box 7, London W3 6XJ

CASHING IN ON PARADISE
11th March

'Ecotourism' offers tourists exclusive access to exotic and fragile environments on a carefully controlled basis. In the Central American country of Belize, a range of scientific disciplines is being used in planning new tourist ventures. **Horizon** investigates what safeguards exist to ensure that ecotourism really does serve to protect the environment.

THE TERRACOTTA TIME MACHINE
18th March

In the 1980s, Britain's museum culture was in crisis. Museums were accused of being stuffy and backward-looking. The Natural History Museum responded by charging for entry, creating a new corporate identity and promising glamorous new exhibitions. But what will be the fate of the museum's great scientific tradition that has made it a 'cathedral of 67,000,000 specimens'? Will science be sacrificed to show business or will the 'terracotta time machine' regenerate itself as a vital data base of the environment?

MEASURING THE ROOF OF THE WORLD
25th March

Mount Everest presents a constant challenge to all adventurers. A century and a half ago it challenged the pioners of modern-day cartography, the mappers who undertook the Survey of India. Today aircraft, satellites and computer technology are building up a complete picture of this vast area.

OTHER TRANSCRIPTS AVAILABLE FROM THIS SERIES OF HORIZON:

Each transcript is £2.00 and cheques, made payable to BSS, should be sent to:
Horizon: (name of programme), PO Box 7, London W3 6XJ

THE MOULD, THE MYTH AND THE MICROBE
8th April

In May 1940 four white mice were rescued from certain death by a substance derived from 'mould juice'. Four years later 40,000 D-Day casualties were treated with it. Penicillin was a miracle. Alexander Fleming became a world hero, often wrongly credited for work he did not do. **Horizon** tells the full story of the scientists who really brought penicillin to the world.

THE FIRST AMERICANS
15th April

Archaeologists have recently uncovered evidence that before Columbus, Aztecs, Incas or Eskimos, a mysterious group of people hunted mammoth, mastadon and giant sloth from the edge of the ice cap in the Yukon to the caves of Patagonia. But who were they, where did they come from and when?

ALSO AVAILABLE FROM
BROADCASTING SUPPORT SERVICES

RED STAR IN ORBIT

A 3-part **Horizon** Special

1. *The Invisible Spaceman.* The story of the man who created a mighty rocket empire which gave the Soviet Union its spectacular lead in the space race. He was known only by the mysterious title, 'chief designer'. Not until after his death was the name of Sergei Korolev revealed. Korelev's emergence from the prison camps of the Gulag is a story of courage and determination, until now kept out of official Soviet records.

2. *The Dark Side of the Moon*. Why did the Soviet Union fail to land a man on the moon? Until recently, they pretended they were not trying. Now the full story of this extraordinary cover-up is emerging. It is a saga of internal feuding, wasted effort and exploding rockets. It was conducted at the height of the space race with Nasa, when the USSR set new records and took great risks: from the first spacewalk to putting three men in space, proving the Russians had the 'right stuff'. For the first time, the cosmonauts and designers talk about their secret mission and the reasons why it failed.

3. *The Mission.* In the summer of 1990 there were fears that the Soviet crew on board the space station Mir might have to be rescued. Instead, the cosmonauts put on space suits and went on a daring emergency space walk to repair jtheir spacecraft. It was the climax of a six -month mission. Filmed over a year, with unprecedented access to the Star City training centre and Baikonur cosmodrome, this is a remarkable record of that mission and the lives of cosmonauts today. Cosmonauts Balandin and Solovyov are now both heroes of the Soviet Union. Like the dozens of veteran cosmonauts before them, they proved they had the Right Stuff.

A combined, illustrated transcript of all three programmes is available, priced £3.50 (cheques made payable to BSS), from:
Red Star in Orbit, PO Box 7, London W3 6XJ.

BBC

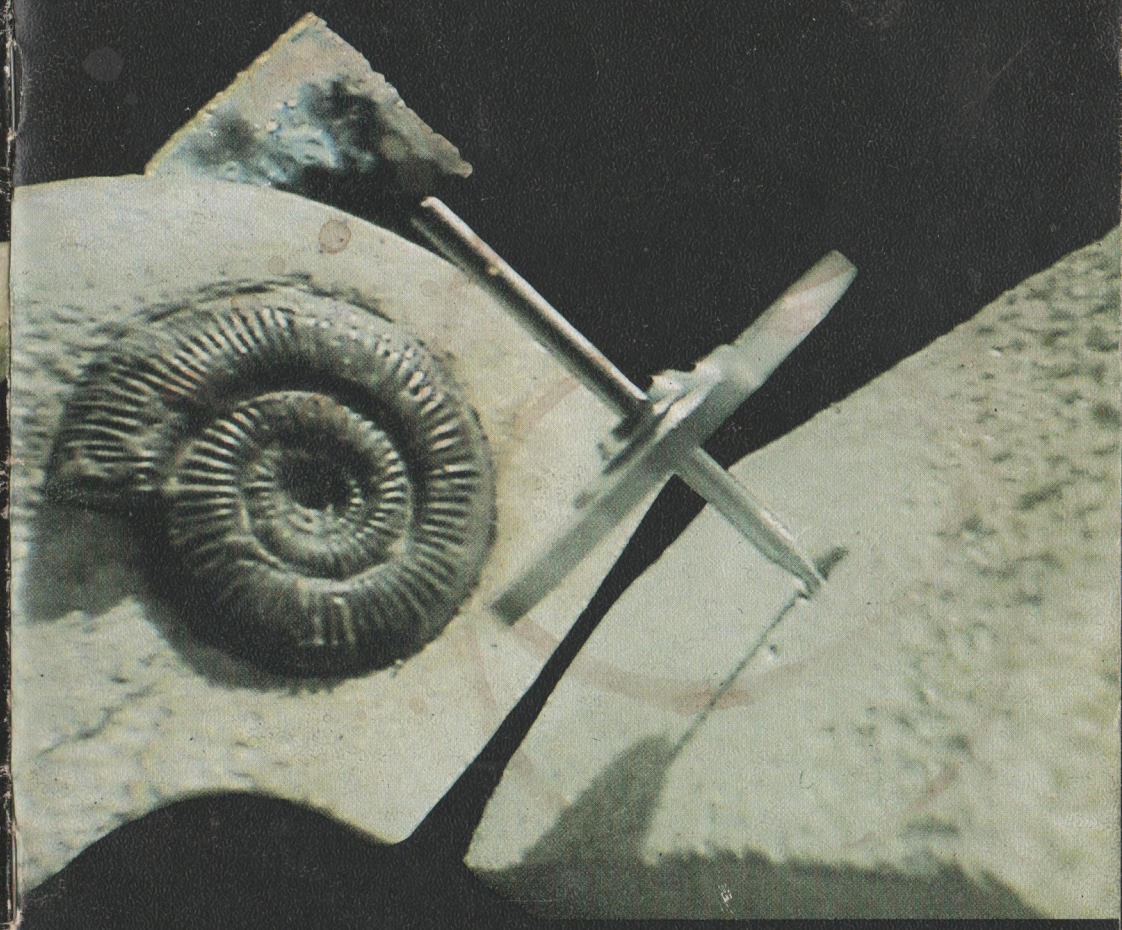
BSS

HORIZON

The BBC's longest running science series continues to reflect the forefront of developments in science, medicine and technology. Each transcript is the result of several months of research and brings together the opinions and knowledge of experts in each field.

In 1991 Horizon is transmitted on BBC2 on Mondays at 8.10 pm and repeated on Wednesdays at 5.10 pm from January to late June.

HORIZON



Colonizing Cyberspace

Transcript of the programme transmitted
22nd April 1991